

A PROFILE OF THE PERSONAL COMPUTING MARKET

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SOME BACKGROUND INFORMATION

BYTE Magazine was the first and remains the leading magazine in the personal computing field. We began our enterprise on May 25 1975, and have been as astounded by the explosion of interest in the field as most of the people attending today's talk. To serve as an introduction and historical measure of what has happened, I'll start with the growth in the circulation of our publication.

When Virginia Peschke and I decided to start a magazine for computer enthusiasts on that day in May of 1975, the known subscriber base of committed enthusiasts was less than 250. This is the number of people who had signed up for my monthly "Experimenter's Computer System" self-published newsletter on how to put together and use an Intel 8008 based home computer system of my own far from perfect design. These people had paid \$21 for 12 issues, of which the typical subscriber had received five 24 page issues during the first five months of 1975. We initially projected a magazine with perhaps 1000 subscribers and 24 pages with 40% advertising. With feedback from advertisers the first issue soon grew to a size of 96 pages and a much larger press run.

The first issue of BYTE went to press 7 weeks after we began the project. It was promoted by means of direct mail lists obtained from charter advertisers as well as a surprising amount of "word of mouth" promotion among computer people around the country. After the initial successful promotion of the magazine, we proceeded to use direct mail marketing techniques as well as advertising in existing trade journals and a variety of general and special interest publications. This marketing of the magazine is still resulting in significant increases in circulation. As of February 1 1977 the statistics for our subscription base of personal computing enthusiasts were a nominal 78,000 copies of the magazine committed to paid customers, and a press run of 85,000 copies of the March 1977 issue of BYTE set to allow for expansion of the customer base during the month of February. If I make the oversimplification of a linear rate of increase in the 20 month span from May 25, 1975 to February 1 1977, the average rate of increase is 3,900 readers per month. Since the BYTE reader represents the typical personal computing

enthusiast at this point in time, this circulation for the magazine sets a lower bound on the total number of people presently interested in personal computing. [BYTE Publications Inc. has applied for membership in the Audit Bureau of Circulations, and we expect to have our first official audit by an outside organization performed for the six months of January to June 1977.]

Who are these personal computing enthusiasts? What do they do with their personal computers? How much have they spent on their enthusiasms? The remainder of this talk and its accompanying paper concerns some objective information and conclusions which are based upon a survey we performed in October and November of 1976 using the mailing list of BYTE's paid subscribers. This information was obtained with the generous help of Mike O'Brian, who used the idea of a market survey of BYTE's readers as the subject of an independent study project in his second year in the MBA program at the Tuck School, Dartmouth College. The survey questionnaire was written by Mike and myself, our office had the form printed, mailed the survey packets, collected the questionnaires as returned in business reply envelopes; Mike arranged for the key-stroking of replies (which we funded), created a data base from the survey using Dartmouth College's Kiewit Computer Center, and provided the statistical analysis of the results upon which this work is based.

A FIRST MARKET VOLUME GUESS

People are always curious about the potential sales volume for the personal computer marketplace. I don't know what the sales volume was for 1976, and I can not predict when or from whom such a figure might become available. We know that our own product's retail sales to enthusiasts are just over \$1 million per annum at the 78,000 level of circulation, based on subscription prices of \$1 per issue and computer store prices of \$1.50 per issue. Lacking any firm sales figure from the manufacturing companies in the field, I propose the following first guess of market volume: our survey found a median income of \$20K per annum for our reader. If we assume that each person with over \$20K income can afford \$2000 per annum for computing enthusiasms, then using our present circulation as a

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basis, we can estimate an annual market sales volume as half the 78,000 circulation multiplied by the \$2000 figure, or \$78 million. This is a figure which seems reasonable, which I'll compare later in this discussion to another estimate based on firmer grounds.

THE SURVEY DATA BASE

The BYTE reader survey was mailed to a list of 2163 names taken from the subscription list as it existed in the first week of October 1976. This list totalled 42,571 paid subscribers, with 9,812 names in a miscellaneous unpaid category which includes new "bill me" subscribers, unexercised renewals, etc. Selecting every nth subscriber and only allowing survey forms to be sent to paid subscribers, the label printing program was modified to generate the survey mailing list. This list was printed as a mailing copy which was applied to envelopes, a confirmation copy on self sticking labels to check off receipt of responses and coordinate reminder postcards, and one additional copy retained for my records. The forms were mailed in the second week of October 1976, with first class postage. Each survey packet contained the 4 page survey form, a reply envelope with business reply mail postage, and a cover letter with an entry blank for a drawing to award five lifetime subscriptions to respondents. (The contest entry blanks were separated from the anonymous survey forms upon receipt in order to respect the privacy of respondents.)

EXTRAPOLATING TO THE ENTIRE MARKETPLACE

The results of our survey I will assume for the purposes of my presentation to be characteristic of the demonstrated personal computing market at this time. I justify this assumption by noting that the BYTE reader is the typical personal computer owner and user, and that the promotional methods used to find our subscribers have not changed in the time interval from September 1976 to February 1977 when this is written. Of course, even if we ignore the generalization to all personal computing users, we must assume that the conclusions drawn from this sample apply to the set of BYTE readers, a set of people which has already demonstrated interest in the products of personal computing manufacturers and editorial copy about how this equipment is designed, built and used.

HOW BIG IS THE DEMONSTRATED MARKET?

Two questions which are often asked of me are: "How many people have personal computer systems?" and "What Size Investment Have They Made?" The answer to the first question is

found by making a simple tally of the responses to our survey question: "Do you own an operating computer system?" Of the 1448 respondents to our survey, 35% replied in the affirmative. Using a linear 1:1 extrapolation to the present BYTE paid readership of 78,000 individuals, this implies that there are presently on the order of 27,000 personal computing systems nationwide in operational condition. I emphasize the phrase "operational condition" since the question was purposely phrased to allow a negative response by individuals with kit or purchased systems which were found impossible to use or operate.

To provide an answer to the second question and a more refined measure of market volume than the guess mentioned previously, the survey attempted to make an appraisal of what investments had been made by the readers polled. Unfortunately, however, we made a mistake in the design of the form which prevented a simple machine tabulation of this information in the analysis available for this paper. Thus an alternative argument based on another item in this survey must be used to develop a lower bound on the total market sales to date.

A market volume estimate can be made by using the surveyed range of memory sizes, the typical current price of memory per unit of 1K bytes, and an estimate of the ancillary equipment cost of a typical small computer system which uses the amount of memory involved. The memory data was tabulated using the two digit number provided by the respondent by filling in the blank in the statement: "My computer system presently has _____ thousand (K) bytes of memory." This information is tabulated for 9 ranges of response in the second column of Table 1.

The data in the second column of Table 1 is a direct count of the number of responses in each range. This data was tabulated with a selection criterion to eliminate people who did not have an operational personal computing system, and we ignored those with less than 1K of memory. The percentage column was then calculated using the total of 1448 respondents as a basis, and the ratio was extrapolated on a 1:1 basis to the present 78,000 circulation of BYTE as shown in the fourth column of Table 1.

How much does a typical segment of memory cost per thousand bytes? No volume statistics are available to me for the purposes of this estimate, so I was unable to properly weight the advertised prices for the various manufactured memory products. To provide a figure, I took the February 1977 issue of BYTE magazine, and went through the advertisements in order to prepare a list of memory products at the board level. I found 13 products in a cursory scan of the advertisements, in the form of 4K, 8K

and 16K byte programmable memory boards, from 6 different manufacturers. Then I simply averaged the price per thousand (K=1024) bytes to arrive at a "typical" memory cost of \$42 per 1K bytes installed, at the board level. It should be noted that this current price reflects recent lowering of memory prices to purchasers as the cost of memory parts from the semiconductor houses has dropped. Thus it is quite likely that the actual prices paid for the memory represented in this extrapolation were from 10% to 30% higher than the current prices. The last two columns of Table 1 show a range of the total installed dollar volume of memory to date based on the \$42/1K byte cost estimate.

The memory investment dollar volume estimates are extrapolated on a 1:1 basis to the 78,000 current circulation of BYTE magazine. At the bottom of the table, a total for the demonstrated

memory sales volume range to date is given. Note that while Table 1 shows a range for memory dollar volume, we could in principal have calculated the figures from the raw data with a precision of 1K bytes instead of the intervals shown in Table 1. The dollar volume range for personal computing memory purchases to date is thus \$13.4 million to \$19.1 million, as measured by this survey.

Based on the figure of 26100 operational personal computing systems with 1K or more memory, I made an estimate of the total processor and peripherals volume to date, using a lower limit of \$1000 and an upper limit of \$1500. This number is conservative, and likely to be on the low side. Consider the fact that just a MITS Altair 8800B and Lear Siegler ADM3A kit total over \$1700 before the addition of mass storage and other necessary peripherals to a typical

Table 1: An estimate of the total dollar volume to date of memory and processor sales at the retail level, based upon a typical current price of \$42/1024 bytes of memory installed, 78000 current demonstrated enthusiasts reading BYTE magazine, and an extrapolated total of 26100 operating computer systems with greater than 1024 bytes of memory.

Memory Range	Count	Percentage (1448 base)	Extrapolated Installed Count	Installed Dollar Range (@ \$42/1024 bytes)	Volume
1K-2K	59	4.1%	3200	\$.13M to \$.27M	
3K-4K	62	4.3%	3300	\$.42M to \$.55M	
5K-8K	80	5.5%	4300	\$.90M to \$ 1.45M	
9K-12K	71	4.9%	3800	\$ 1.44M to \$ 1.92M	
13K-16K	70	4.9%	3800	\$ 2.08M to \$ 2.56M	
17K-24K	62	4.3%	3300	\$ 2.36M to \$ 3.33M	
25K-32K	41	2.8%	2200	\$ 2.31M to \$ 2.96M	
33K-65K	31	2.1%	1700	\$ 2.36M to \$ 4.64M	
66K and up	9	.6%	500	\$ 1.39M to \$ 1.39M*	

Total owners of operating computer systems with 1K or more bytes of programmable memory..... 26100 \$ 13.4M to \$ 19.1M

Allowing a conservative range of \$1000 to \$1500 for processor, video interface, keyboard and other peripherals at the retail level..... \$ 26.1M to \$ 39.2M

Estimated total dollar volume to date..... \$ 39.5M to \$ 58.3M

*We have no upper bound on this range, so the lower bound is used for these estimates.

small computer system. Thus using the observed and well defined memory range and the conservative estimate of \$1000-\$1500 in related investments, we find a demonstrated total sales to date in the personal computing field in the range of \$39.5 million to \$58.3 million. And this number represents the beginning of a still rising market sales curve. This "real world" measurement compares very favorably with the very rough sketch of \$78 million sales made by arbitrarily assuming \$2000 disposable income for computer purchases for people with \$20K per annum income and enthusiastic interest in the small computers and their uses.

WHO COMPUTES ?

One of the purposes of the survey exercise was to provide an estimate of what type of person becomes a computer enthusiast and reader of BYTE. This is information which is important to those seeking an understanding of the market and why it has come about. One way to concisely summarize what we found out about the personal computing user is to state:

"The typical personal computing enthusiast is a well educated, upper middle class male with a professional interest in technology."

We asked a number of questions in a section of the survey labelled "Subscriber Profile" in order to obtain information about the personal characteristics of the computer enthusiasts who read our magazine, build and program home computer systems.

The question "what is your sex?" led to an expected conclusion based upon personal experience and the usual cultural stereotypes. 99% of the respondents who answered this question replied "male," and the 1% who answered "female" represented an absolute count approximately equal to the number who did not answer the question at all. I'll leave the conclusions to be drawn from this to the sociologists in the audience, but it is an empirical fact which can not be ignored: those who get deeply involved with computers tend to be male.

Turning to economic characteristics, the usual question was asked: "What is the income per year in your household?" The answers were indicated by circling one of six ranges, as shown in the lefthand column of Table 2. The seventh line in Table 2, labelled "Excluded" is a tally of the people who did not answer the income question. The median income is \$20K per annum, which can be confirmed by noting that 50% of the respondents indicated \$20K or more.

Table 2: Income of BYTE Readers.

<u>Income Range</u>	<u>Count</u>	<u>Percentage</u>
\$0K-10K	120	8%
\$10K-15K	268	19%
\$15K-20K	317	22%
-----median-----		
\$20K-25K	234	16%
\$25K-30K	221	15%
\$30K+	270	19%
Excluded(no ans.)	18	1%

Another one of the key questions which we asked on our survey is "What is your highest level of formal education? (Please circle the applicable category; consider yourself as having attained a degree if you are actively enrolled in the programs leading to it.)" The categories and counts for each possible answer on the form are summarized in Table 3. As in the previous table of income ranges, the "Excluded" category counts those who did not answer the question for some reason.

Table 3: Education of BYTE Readers

<u>Highest Level</u>	<u>Count</u>	<u>Percentage</u>
High School	163	11%
Junior College	215	15%
Bachelor's Degree	586	41%
Master's Degree	321	22%
PhD Degree	128	9%
MD or DDS	26	2%
Excluded	9	1%

This concentration of people in relatively advanced levels of education is certainly consistent with our intuitive readings of the marketplace. It takes a certain level of creative and intellectually oriented individual to get deeply involved in computer programming with enough dedication to buy build a computer system which costs on the order of \$1000, \$2000 or more. The Whole idea of programming as an avocation and pastime is somewhat akin to other mental exercises such as chess, mathematics, simulations, puzzles, etc. But programming also has elements of excitement due to automation of algorithms and rules. Even if there were no practical attributes of the personal computer, I think the idea of personal computing would tend to be attractive to just the sort of intellectually oriented people who we find in this measurement.

WHAT DO PEOPLE DO WITH PERSONAL COMPUTERS ?

In an effort to find out what applications interests personal computing enthusiasts have, we included an "Applications Survey" section on our form. This section included the question "do you own an operating computer system?" which was mentioned earlier, as well as a list of application areas with three possible responses. Respondents were instructed to circle the "Am using" column if they were applying their computer system for the application in question; the "Intend" column was to be circled if the respondent had not yet done the particular application but intended to do so eventually; the "No Interest" column was provided to complete the logical set of possibilities. The applications were listed in two categories: Hobby or Home Applications, and Professional or Business Applications. Tables 4 and 5 summarize the results as percentages calculated using the total count of respondents, 1448, as a basis.

Table 4: Interest in Hobby or Home Applications

<u>Application</u>	<u>Using</u>	<u>Intend</u>	<u>Serious</u>	<u>Rank</u>
Software development...	27%	52%	79%	1
Interactive keyboard				
games.....	18.4%	53.3%	71.7%	2
Graphics.....	6.8%	64.7%	71.5%	3
Real time control (as				
in household automa-				
tion.).....	6%	59%	65%	4
Personal data bases....	8%	54%	62%	5
Games with analog				
inputs.....	3%	53%	56%	6
Computer design.....	12%	42%	54%	7
Educational,excluding				
games.....	9.9%	42.3%	52.2%	8
Text processing.....	9.5%	42.3%	51.8%	9
Non computer hobby.....	8%	35%	43%	10

Serious := Intend + Using

Table 5: Interest in Professional and Business Applications

<u>Application</u>	<u>Using</u>	<u>Intend</u>	<u>Serious</u>	<u>Rank</u>
Mathematical or data				
analysis.....	27%	34%	61%	1
Simulation or models...	15%	33%	48%	2
Professional data base.	13%	34%	47%	3
Text processing.....	12%	30%	42%	4
As part of a communica-				
tions network.....	11%	29%	40%	5
Accounting.....	8%	31%	39%	6
Scheduling,planning....	6%	27%	33%	7
Inventory control.....	6%	26%	32%	8
Mailing lists.....	6%	23%	29%	9

Serious := Intend + Using

From the interest rankings expressed in our sample, it is clear that the greatest interest in computers is found in the area of home and hobby applications, use of personal computers for "fun" things they can do. One of the most interesting points is the large amount of interest in "software development." Perhaps this is evidence that the personal computing user treats the computer and its programming as an end unto itself. From my own personal experience I find one of the major fascinations of computers to be the art of programming, which is apparently consistent with the results of the applications survey. The interest in games and graphics is also quite high, and might be viewed as coincident with the interest in developing software since both types of application are highly creative and involve large amounts of custom software.

While the home and hobby applications interest claimed the most response, the survey shows professional and business interests consistent with the educational and income items presented earlier. Professional interest was largest in those areas of a scientific, mathematical and engineering nature: mathematical and data analysis, simulation and modelling, professionals' data bases and text processing.

WHAT'S THE TYPICAL ENTHUSIAST'S EXPERIENCE ?

Many people have made armchair speculations about the level of experience and ability present in the computer person who programs and builds hardware for personal use. But with completion of our first reader survey, we now can offer some firm data based on the actual characteristics of the market.

One of the items requested on the survey form was stated: "Please circle the number of years experience you have in each category", where the categories included "Software design (programming)" and "Hardware design." In the analysis of the survey data base, a cross correlation was made between the two categories of experience. In Table 6, the results of this tabulation are shown as counts in each range of experience. The total count was 1347, with 101 exclusions due to people who did not answer both questions.

In analyzing this matrix, I have formed totals for three subset categories: A relative novice is a person with less than 2 years experience in both hardware and software design. An experienced but specialized person has greater than 2 years experience in hardware or software design and less than two years in the other category. A well rounded experienced person is considered to be one with greater than 2 years experience in both categories. With these defi-

nitions, I have noted a summary, with percentages based on the total response of 1448 forms.

Table 6: Software design (down) versus hardware design (across) experience matrix.

		Hardware Design (Years)				
		0-1	1-2	2-5	5-10	10+
Software Design (Years)	0-1.....	219	55	58	35	48
	1-2.....	86	43	52	28	33
	2-5.....	133	51	61	45	27
	5-10....	92	22	49	45	19
	10+.....	51	22	16	16	41

Classifications:	Count	Percent*
Novice (<2 years both categories.....	403	28%
Specialized Experienced (<2 yrs one category). "Well rounded"	625	43%
(> 2 yrs both categories.....	319	22%
Exclusions.....	101	7%

*Percentages calculated with 1448 basis.

Thus I conclude that the bulk of BYTE's readership, and by implication the majority of those presently practicing the personal computing arts, have decided to pursue personal uses of computers based upon some prior involvement in the fields of software or hardware design. If we select those who have greater than 2 years experience in either hardware or software design areas, the sum of my "specialized" and "well rounded" categories is 65% of the total sample.

Moving from the generalities of "hardware" or "software" experience, the survey asked for information on specific low level language experience in several categories of computer. The data measured in this area, along with the categories involved is presented in Table 7. The percentages shown are calculated using the total survey response of 1448 persons as a basis. The figures of 51% for large computer experience and 59% for minicomputer experience are certainly consistent with the more general measure from Table 6 of 65% with greater than 2 years experience in either hardware or software. The rankings for microprocessor architectures find the leader to be the 8080, followed by the 6800 and third place LSI-11. Remember that this is a ranking based on the request: "please indicate whether or not you have had experience with the machine or assembly language for..." so it gives a measure of the familiarity of readers with the machine specific programming features of these architectures, but ignores machine independent high level languages. The number

In order to provide a measure of interest in and experience with high level languages, we

Table 6: Experience with the machine language or assembly language of specific computers or classes of computers. Percentages calculated on a 1448 response base.

Category	Counts	Percent
Any large computer.....	739	51%
Any minicomputer.....	849	59%
Motorola 6800.....	338	23%
MOS Technology 6502.....	163	11%
Intel 8080.....	607	42%
Zilog Z-80.....	114	8%
Intersil IM6100.....	67	5%
Digital Equipment LSI-11....	185	13%
RCA 1802.....	59	4%
Signetics 2650.....	35	2%
National PACE.....	62	4%

Table 7: Language and programming experience and intentions. All percentages based on 1448 respondents.

	Frq.	Occ.	Lit.	Int.	None	Excl
Machine Language	26%	40%	66%	14%	17%	3%
Assembly Language	31%	34%	65%	18%	13%	3%
BASIC	21%	38%	59%	25%	14%	2%
FORTRAN	26%	43%	69%	11%	18%	2%
PL/I	6%	13%	19%	19%	54%	8%
Algol	3%	13%	16%	10%	66%	8%
COBOL	8%	15%	23%	11%	58%	8%
APL	3%	10%	13%	20%	59%	8%
RPG	2%	8%	10%	9%	73%	8%
Ded.Appl.Lang.	12%	19%	31%	12%	48%	9%

Definitions:

Frq. = frequent use, currently.

Occ. = occasional use, or past use frequently.

Lit. = literacy = Frq + Occ (ie: know language)

Int. = intend to learn language.

None = no interest in language.

Excl = exclusions, did not answer question.

provided a place on the form for respondents to indicate experience with high level languages. A selected list of languages, shown in Table 7 was provided with four options to circle. "Frequent" was to be circled by individuals who regularly use the language, "Occasional" by individuals who use it from time to time or at one time used it frequently, "intended" was to be circled if the language was on the respondent's list of languages to learn at some point in time, and "none" provided the final category for no interest whatsoever. In analyzing the counts for each category I formed a sum of the "frequent" and "occasional" columns as "literacy" in the language. These two columns represent people who know the language in question, and can be said to be literate. Using the "literacy" figure as a ranking

figure, it is clear that FORTRAN dominates the field, followed closely by machine language and assembly language programming, then BASIC. At a distant fourth place is familiarity with some form of dedicated application language and COBOL. Ranking by intention to acquire literacy, the most desired languages are BASIC and APL, followed by PL/I and Assembler languages.

As an aside, Table 7 neatly sorts out the computer languages according to a "puzzlement factor". If we attribute the exclusions (the people who did not circle anything) to people who don't understand the question, then there is a neat division of the results into those with 2 or 3% exclusions (top of table) and those with 8% (or 9%) exclusions. I'll not venture to explain this beyond the conjecture that it is due to puzzlement and unfamiliarity with the particular language's characteristics.

IN CONCLUSION....

What I have attempted to show with this work is a rough profile of the type of person who is involved in personal computing, his prior experience in computing and related technological areas, and his economic profile both in terms of income and demonstrated investments in memory and equipment. We've found an economically well off individual, with an enthusiasm and technical competence in the areas of computer hardware and software.

This is probably the first such survey to be published which has any direct basis in the actual demographics of personal computing users since its target group comprises the largest known set of such enthusiasts.